FOREST PRODUCTS
Project Fact Sheet

3D CHARACTERIZATION OF THE STRUCTURE OF PAPER AND PAPER BOARD AND THEIR APPLICATION TO OPTIMIZE DRYING AND WATER REMOVAL PROCESSES AND END-USE APPLICATIONS

BENEFITS

- Maximizes use of fiber furnish
- Optimizes existing water removal and drying processes
- Increases energy and cost efficiency of water removal processes
- Improves quality of paper and paperboard under varying end-use applications
- Enhances understanding of how papermaking processes affect structure and quality of the final paper sheet

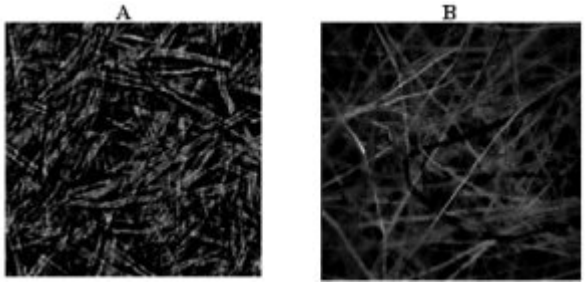
APPLICATIONS

3D structure characterization of paper and paperboard will replace older methods of pore structure analysis such as mercury intrusion porosimetry. This technology can help optimize the composition of fiber furnish and selection of chemical additives by targeting selected paper properties and end-use applications. 3D characterization studies will create optimal energy and cost efficient water removal processes.

Researchers Will Use 3-D Analysis to Improve Paper Quality and Optimize Water Removal Processes

Pore characteristics may provide insight into paper and paperboard transport properties such as water vapor diffusivity and liquid permeability. Since transport properties determine paper manufacturing process efficiency and variation in end-use applications, an accurate structural assessment of paper is essential to improving yield, efficiency, and quality. Experimentation on a new 3-dimensional technology will examine the bulk structure of paper by determining the relationship between porous structure characteristics and transport properties.

A novel imaging technique, Laser Scanning Confocal Microscopy (LSCM), scans through paper thickness with a laser light to offer a sharp representation of the medium. X-ray computer tomography (X-ray CT) NMR-magnetic resonance imaging (NMR-MRI), and sophisticated image analysis techniques will be used to complete the characterization. Results of these analyses will reveal how pore structure characteristics affects paper and paperboard transport properties. The link between these traits could be used to optimize and improve methods of papermaking, drying, water removal, and/or end-use applications.



A)Micro X-ray CT Image of paperboard
B)LSCM Image of paper sample

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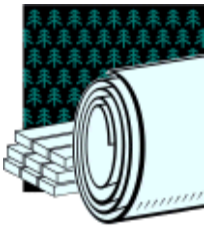
PROJECT DESCRIPTION

Goal: To create an accurate, direct, and non-invasive measurement method for paper and paperboard pore structure visualization and characterization.

This three year project will be undertaken by the University of Minnesota (U MN) and the State University of New York, College of Environmental Science & Forestry (SUNY-ESF). The best technique for scanning and visualization will be determined in the first year while conducting permeability and diffusivity tests. During year two, researchers will develop and implement methodology to characterize pore structure. The focus of the third year will be to refine the steps outlined above and create computer models based on liquid and vapor flow through varying paper structures.

PROGRESS & MILESTONES

- Recent investigation has shown that moisture transport occurs by vapor phase diffusion through the pores and bound water diffusion through the fibers.
- Researchers found that moisture uptake in fibers can be best described by a first-order relaxation process.
- Development of the technique to scan and visualize the 3-D bulk structure of paper and paperboard is currently underway.
- The LSCM technique was explored and was found to be most suitable for non-intrusively visualizing the top layers of the sheet.
- Researchers are looking into a way to increase scanning depth while maintaining quality through alternative scanning techniques.
- Micro X-ray Computed Tomography (micro X-ray CT) has been found suitable to non-intrusively visualize entire thickness of even paper board samples.
- Efforts are underway in exploring the use of higher resolution (~1:m) micro X-ray CT in thick paper board samples.



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